JPL

Space Interferometry Mission

SIM

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Space Interferometry Mission (SIM) Presentation to Origins Subcommittee

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SIM Project Manager

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SIM Status

- Completed redesign activity and recommended Shared Baseline Design
  - Retained over 90% of original SIM science
  - Significant reduction in system complexity
  - Reduced both mission cost and risk
- Completed Code S chartered External Review Board (ERB) Review, LaRC Independent Program Assessment Office cost and risk evaluation, and Code S Management Review
- Received written approval to proceed in Phase A with the Shared Baseline design
- Developed technology milestones and schedule
  - Defined specific milestones for Phase B and Phase C/D transition
  - Technology completion is our highest priority
- SIM Project is proceeding in Phase A

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Proposed Level 1 Requirements

(Source: SIM Formulation Authorization Document signed 1/00)

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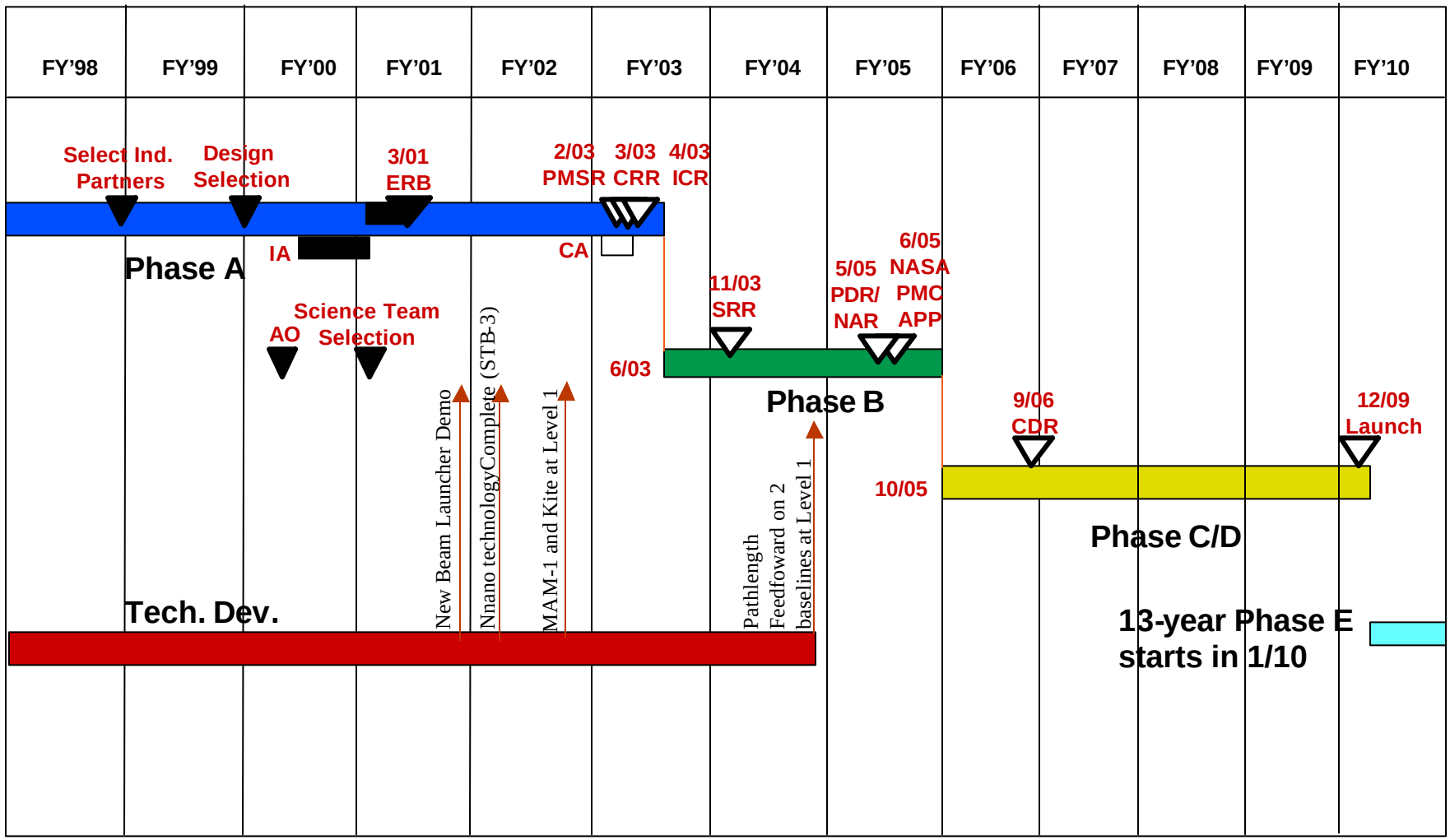
SIM Science Requirements		
	Minimum Requirement	Goal
Narrow Angle Astrometry	3 ?as accuracy (1 sigma) in a single measurement over a 1 deg FOV. Target and four reference stars as faint as V=12 mag in < 1 hr for a measurement in one orientation	1 ?as accuracy (1 sigma) in a single measurement over a 1 deg FOV. Target and four reference stars as faint as V=12 mag in < 1 hr for a measurement in one orientation
Global Astrometry	Better than 30 ?as (1 sigma) at end of 5 year mission over the entire sky for stars brighter than V=20 mag.	4 ?as (1 sigma) at end of 5 year mission over the entire sky for stars brighter than V=20 mag.

SIM Technology Requirements	
Use of Interferometry Techniques	Demonstrate a space interferometer system (with long baseline operating in short wavelength) having capability of active pathlength stability control and pathlength knowledge consistent with the astrometric science goals
Demonstration of Synthesis Imaging	Provide "uv-plane" coverage adequate to image ~~up to 50~~ a few point source~~s~~ located within a 2 arcsec field ~~the approximate 1 degree primary beam of a single telescope, e.g. for imaging the core of a globular cluster.~~
~~*Demonstration of Starlight Nulling*~~	~~Better Active pathlength control and nulling instrumentation adequate to reduce the intensity of light in a ≥20% spectral bandwidth from a star by a~~ factor of 10^{4} for proiods as long as 1 hour.

SIM Project Schedule



ATLO = Assy, Test & Launch Ops
CA = Confirmation Assessment
CDR = Critical Design Review
CR = Confirmation Review (NASA PMC)
ERB = External Review Board
IA = Independent Assessment
I&T = Integration & Test
PMSR = Preliminary Mission & Systems Review
NAR = Non Advocate Review
PDR = Preliminary Design Review
NASA PMC = Programmatic Management Council (APP = Approved)
SRR = System Requirements Review
CRR = Confirmation Readiness Review (JPL PMC)
ICR = Initial Confirmation Review (Code S)

Phase B Technology Gate/Status

- August 2001 - Demonstrate brassboard beam launcher performance of less then 100pm uncompensated cyclic error and less then 20pm/mK bulk thermal sensitivity
  - Completes component technology
  - Two beam launcher types - internal and external - both based on same design
  - Internal launcher has met the requirement. External launcher is in test
- December 2001 - Demonstrate stabilized fringes of a faint science star on STB-3
  - Completes the nanometer technology
  - Activity progressing on schedule
- July 2002 - Demonstrate MAM-1 performance at a level consistent with the Level 1 Narrow Angle Science requirements
  - Demonstrates microarcsecond performance on a single baseline interferometer
  - Activity progressing on schedule
- July 2002 - Demonstrate external metrology performance consistent with the Level 1 science requirements on the 6-gauge experiment
  - Activity progressing on schedule

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SIM Astrometric Performance
--Based on "today's" component Technology

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	Parameters	Parameter Performance Today	Parameter Performance Needed by NAR	SIM Wide angle (WA) & Narrow Angle (NA) Performance *What if all other parameters improve to the NAR level but no more improvement on this one*
1	Beam launcher thermal sensitivity (bulk, gradient)	6 pm/mk	2 pm/mk	4.97 μas/ 1.03 μas
2	Cyclic averaging residual error per gauge	50 pm	5 pm	4.83 μas/ 1.22 μas
3	Pointing dither error per gauge	750 mas	75 mas	5.94 μas/ 3.2μas
4	Corner cube surface quality	lamda/500	lamda/500	4.77 μas/ 1.00μas
5	Wide angle error due to beam diffraction	200 pm	100 pm	5 μas (WA)
6	Narrow angle error due to beam diffraction	13 pm	2.7 pm	1.04 μas (NA)
7	Wide angle error due to polarization effects on corner cubes	75 pm	15 pm	5.14 μas (WA)
8	Narrow angle error due to polarization effects on corner cubes	5 pm	1 pm	1.06 μas (NA)
9	1-D absolute metrology accuracy	30 μm	3 μm	4.87 μas/1.33μas
10	Wide angle PSS end-to-end thermal deformation	100 μm	10 μm	5.01 μas (WA)
11	Narrow angle PSS end-to-end thermal deformation	10 μm	1 μm	1.01 μas (NA)
12	Systematic fringe measurement error	150 pm	30 pm	5.20 μas/ 1.99 μas
	Wide Angle Performance (General Astrophysics) 4 μas (goal); 30 μas (min)	**7.1 μas (was 29 μas)**	**3.9 μas**	
	Narrow Angle Performance (Planet Detection) 1 μas (goal); 3 μas (min)	**3.8 μas (was 6 μas)**	**0.8 μas**	

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High confidence via experiment in SIM-like configuration/environment or previous experience

Moderate confidence via analytical result or experiment in less SIM-like configuration/environment

Summary

- SIM Team developed a design that met the cost cap and provided significant cost and risk reduction
- Shared Baseline design preserves over 90% of the SIM science
- SIM has baselined a Shuttle launch with a TRW Integral Propulsion System based upper stage
  - We will maintain an EELV launch option until the start of FY04
- We have identified the critical technology milestones required for entry into Phase B and Phase C/D
- We are on schedule for completion of technology milestones

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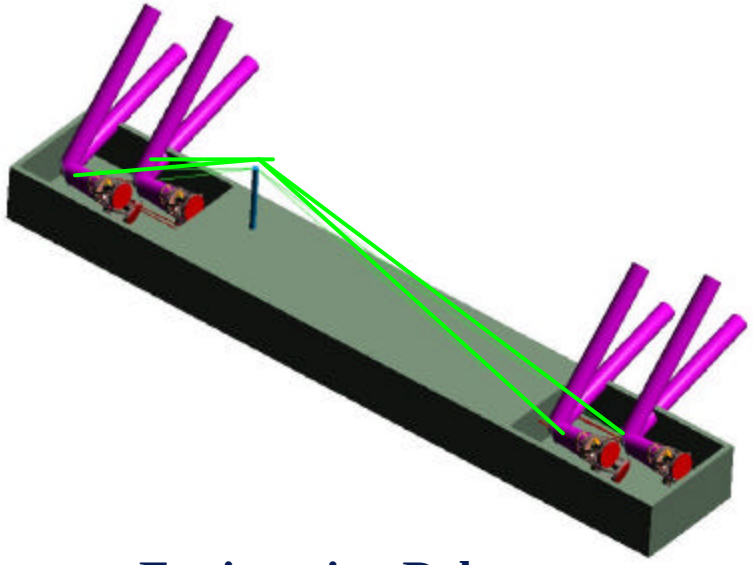
Backup

Shared Baseline SIM



- **Description**
  - Combines the best of SIM-Classic and SIM-SOS into a lower cost design
  - Most similar to SIM-Classic design
    - Best understood of the options
    - Best performance of the options
  - Best redundancy capability
  - Provides descope options

- **Engineering Deltas**
  - Greatly reduces external metrology (ET) boom complexity, and reduces number of ET beams from 36 to 18
  - Two Baselines, two Interferometers per baseline (one interferometer for redundancy)
  - Two interferometers on a single baseline share siderostat mirrors and use wide field-of-view Three-Mirror Anastigmat (TMA) telescopes

- **Science Capability**
  - Same number of observations as SIM-C
  - Retains baseline planet finding capability
  - Retains capability to do the GRID
  - Retains baseline global astrometry capability
  - Retains imaging demonstration capability (single U,V ring)
  - No nulling capability

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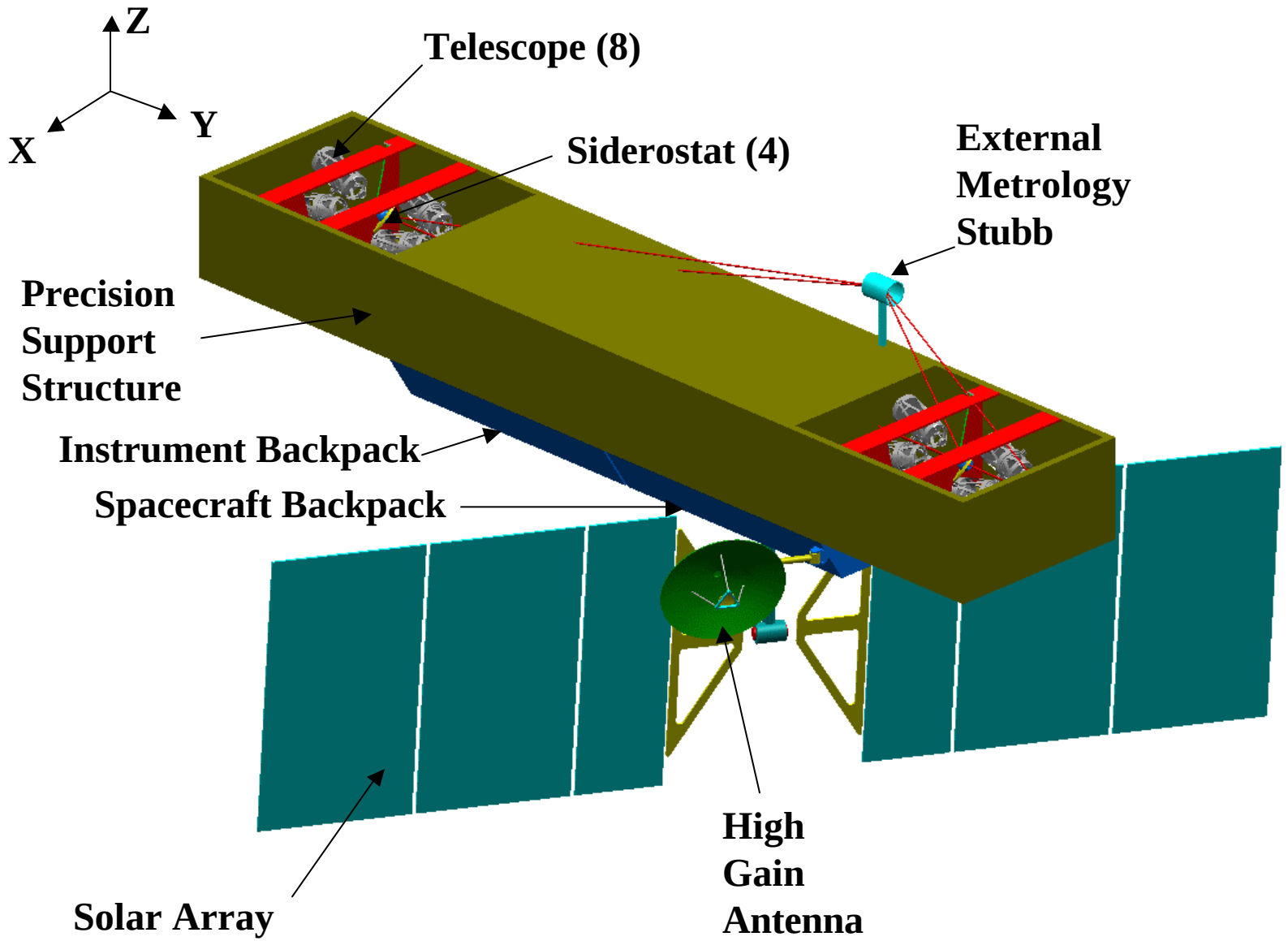
SIM Shared Baseline Configuration



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